

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number  
**WO 2004/000986 A1**

(51) International Patent Classification<sup>7</sup>: **C11D 3/39**  
(21) International Application Number:  
PCT/EP2003/005674

(22) International Filing Date: 30 May 2003 (30.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
102 27 774.5 21 June 2002 (21.06.2002) DE

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(81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,  
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ,  
VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,  
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Declaration under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted  
a patent (Rule 4.17(ii)) for the following designations AE,  
AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH,  
CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI,  
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG,  
KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK,  
MN, MW, MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU,  
SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG,  
UZ, VC, VN, YU, ZA, ZM, ZW. ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW). Eurasian  
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM). European  
patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,  
GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).  
OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
ML, MR, NE, SN, TD, TG)

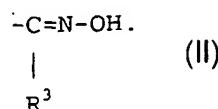
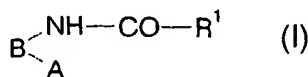
**Published:**

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2004/000986 A1

(54) Title: USE OF TRANSITION METAL COMPLEXES WITH NITROGEN-CONTAINING POLYDENTATE LIGANDS AS A BLEACHING CATALYST AND BLEACHING AGENT COMPOSITION



(57) Abstract: Transition metal complexes are used as bleaching catalysts for peroxy compounds. Transition metal complexes to be used according to the invention contain a ligand of the general formula (I) wherein B is a bridge member, such as o-phenylene or pyridine-2,6-diyl, and A represents the group -NH-CO-R<sub>1</sub> or formula (II).

**Use of transition metal complexes with nitrogen-containing  
polydentate ligands as a bleaching catalyst and bleaching  
agent composition**

**Description**

- 5 The invention relates to the use of transition metal  
complexes with nitrogen-containing polydentate ligands as a  
bleaching catalyst and to bleaching agent compositions  
comprising such a bleaching catalyst. The activity of  
peroxy compounds in washing, bleaching and cleaning  
10 processes at low temperature is increased by the transition  
metal complexes to be used according to the invention.

Inorganic peroxy compounds, in particular hydrogen peroxide  
and compounds which liberate hydrogen peroxide, such as  
sodium perborate monohydrate, sodium perborate tetrahydrate  
15 and sodium percarbonate, have been employed for a long  
times as oxidizing agents in bleaching, washing and  
cleaning processes. Sufficiently rapid bleaching of soiled  
textiles requires a temperature of at least 80°C.

- The oxidizing action of inorganic peroxygen compounds at  
20 reduced temperature can be improved by co-using so-called  
bleaching activators. Bleaching activators are, in  
particular, N- and O-acyl compounds, for example  
polyacylated alkylenediamines, such as  
tetraacetylenehydrazine (TAED), acetylated glycolurils,  
25 N-acetylated hydantoins, diketopiperazines, carboxylic acid  
anhydrides, carboxylic acid esters, such as, in particular,  
sodium nonanoyloxy-benzenesulfonate (NOBS), and acylated  
sugar derivatives.

- By using a combination of a peroxy compound and an  
30 activator, bleaching can be carried out at about 60°C  
instead of above 80°C without a loss in activity.

In efforts to be able to carry out washing and bleaching below 60°C, the use of transition metal complexes, in particular complexes of manganese, iron, cobalt and copper with at least one polydentate organic ligand, in particular  
5 nitrogen-containing ligands, has been described in many documents.

Reference is made by way of example to the complexes described in the following documents: EP 0 544 490, WO 98/54282, WO 00/12808, WO 00/60043, WO 00/52124, EP 0 392  
10 592, WO 99/64156 and WO 00/12667.

Although numerous different transition metal complexes are thus known for the use aimed for, they only partly meet some of the expectations imposed on them.

Thus, if the reactivity is too high there is the risk of a  
15 change in colour of dyed textiles, and in the extreme case oxidative damage to the fibres. Furthermore, some complexes decompose the peroxygen compound without a bleaching action, are insufficiently stable to hydrolysis or are susceptible to oxidation.

20 The doctrine of WO 00/32731 is bleaching catalysts with di(2-pyridyl)methylamine organic nitrogen-containing ligand. This catalyst is suitable for increasing the oxidizing and bleaching action of hydrogen peroxide. A further increase is achieved by combination of such a  
25 bleaching catalyst with a so-called activator which can form a peroxycarboxylic acid in the presence of a source of hydrogen peroxide. As has been shown in practice, different property profiles of bleaching catalysts which the products known to date do not achieve in all points are required in  
30 washing, bleaching and cleaning compositions.

The international application WO 98/03263 discloses homogeneous oxidation catalysts, these being transition metal complexes with a macrocyclic ligand. The ligand

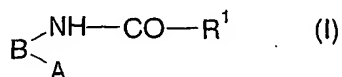
includes four donor atoms, such as nitrogen, usually in the form of amides, so that the ligand is a tetraamide. Further similar macrocyclic ligands and chelate complexes are the doctrine of WO 99/64156, where the ligand can contain four  
5 amidic or also two aminic and two amidic nitrogen atoms. Such ligands are indeed stable to oxidation, but the activity as a bleaching catalyst leaves something to be desired.

The object of the present invention is accordingly to  
10 provide further transition metal complexes with at least one nitrogen-containing polydentate ligand which are suitable as a bleaching catalyst for activation of a peroxy compound and preferably also oxygen.

It has been found that transition metal complexes with a  
15 transition metal from the series consisting of manganese, iron, cobalt or copper are very active and gentle bleaching catalysts if these contain at least one nitrogen-containing polydentate ligand of the general formula (I) according to the claims.

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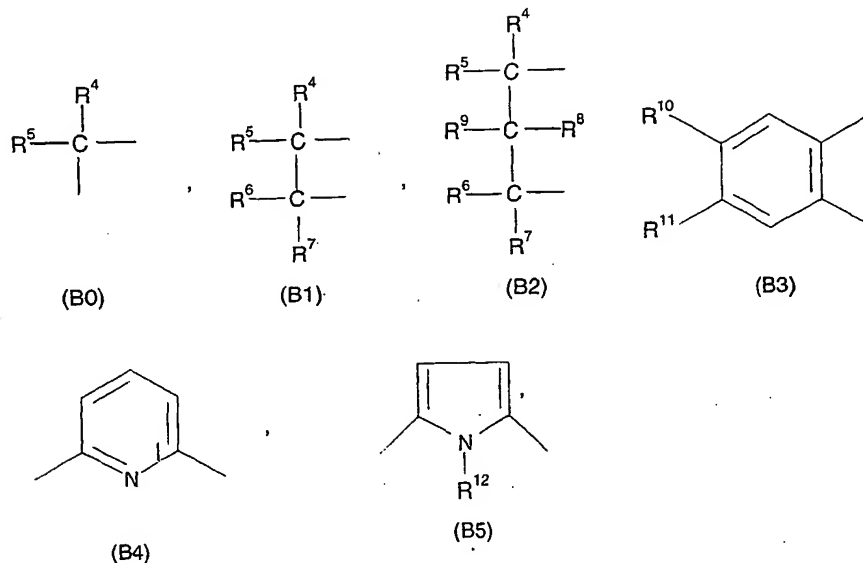
The invention thus provides the use of a transition metal complex with at least one nitrogen-containing polydentate ligand as a bleaching catalyst for activation of a peroxy compound or of oxygen, wherein  
25 the complex is mono- or polynuclear, the transition metal (M) is manganese, iron, cobalt or copper and the nitrogen-containing polydentate ligand (L), at least one of which is present, has the general formula (I)



wherein A represents either the group  $-\text{NH}-\text{CO}-\text{R}^2$  or the group  $-\text{C}=\text{N}-\text{OZ}$ ,



the bridge member B is chosen from the series consisting of



wherein  $\text{R}^4$  to  $\text{R}^7$  independently of one another represent a radical from the series consisting of H, arylalkyl, aryl, heteroaryl,

wherein  $\text{R}^4$  with  $\text{R}^5$  or/and  $\text{R}^6$  with  $\text{R}^7$  or  $\text{R}^4$  with  $\text{R}^6$  together with the atom(s) carrying them can form a five- to seven-membered, in particular five- or six-membered cycloaliphatic or O- or N-heterocyclic ring, which can also contain a double bond,

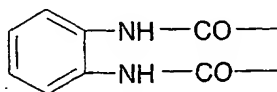
and wherein the structural elements of the general formulae (B0) to (B5) have a total of 2 to 20 C atoms,  $\text{R}^8$  and  $\text{R}^9$  independently of one another can represent a radical from the series consisting of H, methyl or together can represent carbonyl oxygen,

$\text{R}^{10}$  and  $\text{R}^{11}$  independently of one another can represent a radical from the series consisting of H,  $(\text{C}_1-\text{C}_4)$ alkyl,

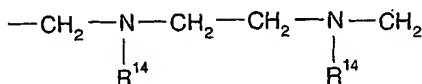
halogen or together can represent a fused-on aromatic ring

and  $R^{12}$  can represent H or methyl,

the radicals  $R^1$  and  $R^2$  independently of one another can represent a radical from the series consisting of  $-\text{COOH}$ ,  
 5  $-\text{CONH}_2$ ,  $-\text{CONHR}^{13}$ ,  $\text{C}(\text{CH}_3)_2\text{OH}$ , 2-pyridyl, 1,3-oxazolin-2-yl, imidazol-2-yl or  $R^1-R^2$  together can represent the radical



or

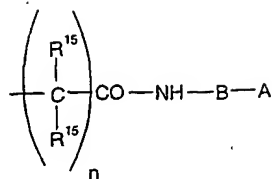


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wherein  $R^{13}$  can be chosen from the series consisting of linear, branched or cyclic alkyl, aryl, heteroaryl, in particular 2-pyridyl, 1,3-oxazolin-2-yl and imidazol-2-yl and heteroalkylmethyl,

15  $R^{14}$  can be chosen from the series consisting of substituted or unsubstituted, linear, branched or cyclic alkyl, benzyl, aryl, heteroaryl, heteroarylmethyl, and  $R^3$  represents a radical from the series consisting of alkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl and  
 20 Z represents H, alkyl, aryl, dialkylaminoethyl, heteroaryl,

and in the case of the oximes  $R^1$  additionally can represent the radical

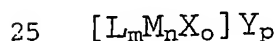


wherein  $n$  is 0 or 1,  $\text{R}^{15}$  H or alkyl, and the group  $\text{R}^{15}\text{-C-R}^{15}$  can be cycloalkyl.

- 5 The subclaims relate to preferred embodiments of the use according to the invention.

The present invention also provides the bleaching agent composition defined in the claims, which comprises a peroxy compound, in particular a source of hydrogen peroxide, and  
 10 a transition metal complex to be used according to the invention in an amount effective for activation. The subclaims of the bleaching agent composition relate to preferred embodiments thereof.

The transition metal complex to be used according to the  
 15 invention can be mono- or polynuclear and contains as the transition metal one from the series consisting of manganese in the valency level II to IV, iron in the valency level II or III, cobalt in the valency level II or III and copper in the valency level I or II. Depending on  
 20 the number of heteroatoms capable of ligand formation and their steric alignment in the ligand L, the complex can contain one or more transition metal atoms, preferably one or two metal atoms of the same type. In general the complex has the general formula



In this formula, L denotes the ligand to be used according to the invention, M denotes a transition metal atom from the abovementioned series, X denotes a coordinating neutral or mono- or polyvalent ligand for saturation of the ligand sphere and Y denotes a non-coordinating counter-ion, which can be anionic or, if the sum of anionic ligands X and ionic substituents in the ligand L exceeds the sum of the valency of the metal atoms M, can also be cationic. The index m represents an integer in the range from 1 to 4, in particular 1 or 2, the index n represents an integer, preferably 1 or 2, the index o represents zero or an integer in the range from 1 to 8 and the index p represents zero or an integer in order to achieve a complete charge compensation. Y can also be a substituent, such as carboxylate or sulfonate, in the ligand.

The polydentate ligand L to be used according to the invention has the structure according to the general formula (I) already shown. According to a preferred embodiment, the complexes are cobalt complexes with the ligand  $B(NH-CO-R^1)_2$ , wherein, particularly preferably, B represents optionally substituted ortho-phenylene and/or  $R^1$  represents a radical from the series consisting of COOH, CONHR',  $C(CH_3)_2OH$  where R' is H,  $(C_1-C_4)$ -alkyl or substituted alkyl and 2-pyridyl.

The bleaching activators to be used according to the invention can in some cases also be macrocyclic, but the ligands differ from the ligands according to WO 98/03263 and WO 99/64156 by at least one feature.

Ligands of preferred bleaching activators are open-chain, that is to say not macrocyclic. Several of these substances are more easily obtainable than the macrocyclic ligands which are already known. Surprisingly, the substances of sometimes simple structure with oxamic acid or oxamide structural elements show a surprisingly good bleaching-activating action. Apart from on the ligand structure and



on the metal atom of the complex, the action also depends in part on the coloured substance to be bleached.

A new genus of active transition metal complexes contain a chelate ligand with four nitrogen donor atoms, two of which have an amide structure and two N atoms of which are the constituent of an N-heterocyclic ring.

Finally, ligands with two amide groups and two oxime groups are interesting compounds for complexing of Mn, Fe, Co and Cu for the purpose of obtaining active bleaching activators.

The cyclic bridge members B can also have functional or non-functional substituents, for example OH, NH<sub>2</sub>, COOH, SO<sub>3</sub>H, COOMe, SO<sub>3</sub>Me, wherein Me represents an alkali metal, N<sup>+</sup>(C<sub>1</sub>-C<sub>4</sub>-alkyl)<sub>4</sub>, F, Cl, alkoxy, in particular (C<sub>1</sub>-C<sub>4</sub>)alkoxy, alkyl, in particular (C<sub>1</sub>-C<sub>4</sub>)alkyl, phenyl, benzyl, pyridyl, 2-pyridylmethyl.

The radicals R<sup>1</sup> and R<sup>2</sup> in the ligand L can be identical or different and represent H, linear, cyclic or branched alkyl or heteroalkyl, aryl, heteroaryl, arylalkyl and heteroarylalkyl. Examples are methyl, ethyl, i-propyl, tert-butyl, benzyl, phenyl, pyridyl, in particular 2-pyridyl, 1,3-oxazolin-2-yl, 1,3-oxazolin-2-methyl and 2-pyridylmethyl.

The radical R<sup>3</sup> in the ligand L can be aryl, heteroaryl, alkoxy, aryloxy, heteroaryl, alkyl and arylalkyl. The examples mentioned above for R<sup>1</sup> and R<sup>2</sup> also apply here. If R<sup>3</sup> represents alkoxy or aryloxy, it is preferably methoxy,

ethoxy, 2-hydroxyethoxy, 2-aminoethoxy, 2-N,N-di(C<sub>1</sub>-C<sub>4</sub>)alkylaminoethoxy and phenoxy.

Both the radicals R<sup>1</sup> to R<sup>3</sup> and bridge members (B1 to B5)  
5 can have one or more functional or non-functional  
substituents. These are those substituents such as have  
already been disclosed in connection with the description  
of the bridge member B. According to particularly preferred  
embodiments, the heterocyclic or heteroaromatic ring  
10 systems bonded to the bridge member B contain one or more  
linear or branched (C<sub>1</sub>-C<sub>4</sub>)alkyl groups, in particular  
methyl, isopropyl and tert-butyl, and furthermore phenyl,  
benzyl, 2-pyridylmethyl or -ethyl or 4-imidazolylmethyl or  
-ethyl.

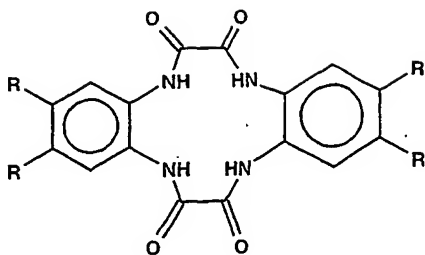
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According to a further preferred embodiment, one or more  
radicals from the series consisting of R<sup>1</sup> to R<sup>15</sup> or the  
nitrogen-containing ring systems formed therefrom contain  
hydrophilic substituents in order to increase the  
20 solubility of the complex. Examples of these are salt-  
forming functional substituents and hydroxyalkoxy  
groupings, which additionally can also contain one or more  
ether bridges.

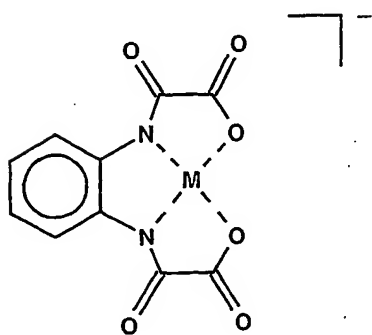
25 The chemical name for some examples of suitable ligands and  
the formulae of some complexes containing them follow  
below:

5,8,13,16-tetrahydro-5,8,13,16-tetraaza-  
dibenzo[a,g]cyclododecene-6,7,14,15-tetraone (TTBP)

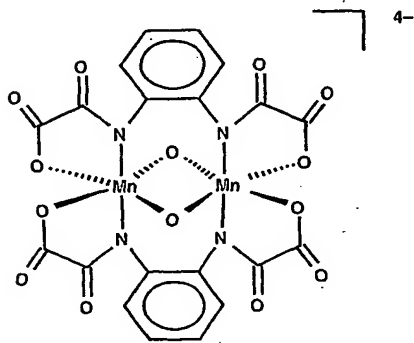
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1,2-phenylene-bisoxamic acid (OPBA)



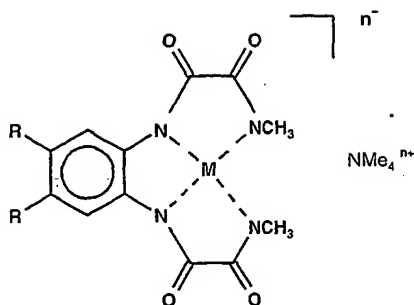
Mn complex of 1,2-phenylene-bisoxamic acid



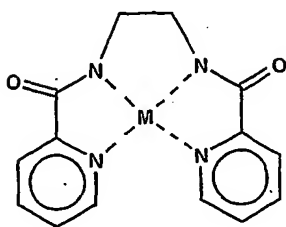
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N-methyl-N'-[2-(methyaminooxalylamino)phenyl]oxalamide  
(PBOMA)N-[4,5-dichloro-2-(methyaminooxalylamino)phenyl]-N'-  
methyloxalamide (for R = Cl)

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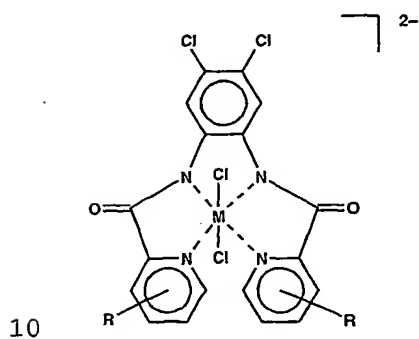
N,N'-bis(pyridine-2-carboxamido)-1,2-ethane (BPEN)



5

1,2-bis(pyridine-2-carboxamido)-4,5-dichlorobenzene (PCADB)

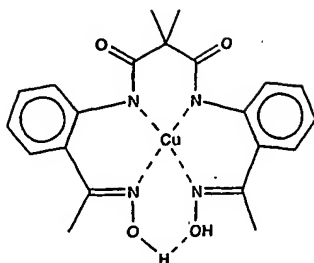
1,2-bis(4-*tert*-butylpyridine-2-carboxamido)-4,5-dichlorobenzene (for R = *t*Bu)



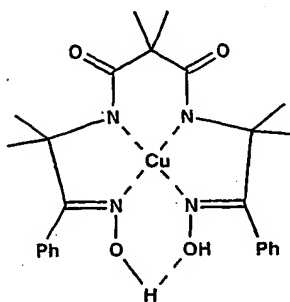
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N,N'-bis[2-(1-hydroxyiminoethyl)phenyl]-dimethylmalonodiamide

12.



N,N'-bis[2-(2-methyl-1-oxo-1-phenyl)propyl]-  
dimethylmalonodiamide



5

Apart from the ligand L, the catalyst can additionally contain coordinating co-ligands X. X here can be a mono-, di- or trivalent anion or a neutral molecule, which can be coordinated with the transition metal in a mono-, bi- or tridentate manner. The co-ligand is preferably the following groupings: OH<sup>-</sup>, O<sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>, CN<sup>-</sup>, SCN<sup>-</sup>, HSO<sub>4</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, F<sup>-</sup>, ClO<sub>4</sub><sup>-</sup>, OCN<sup>-</sup>, HCO<sub>3</sub><sup>-</sup>, RS<sup>-</sup>, CO<sub>3</sub><sup>2-</sup>, SO<sub>3</sub><sup>2-</sup>, RSO<sub>3</sub><sup>-</sup>, S<sub>2</sub>O<sub>6</sub><sup>2-</sup>, RCO<sub>2</sub><sup>-</sup>; H<sub>2</sub>O, ROH, CH<sub>3</sub>CN, NRR'R''.

15

The counter-ion Y of the complex to be used can be anionic or cationic, wherein the number p is chosen such that complete charge compensation is achieved. The counter-ion can preferably have the following meaning: F<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, RSO<sub>3</sub><sup>-</sup> (R e.g. preferably CF<sub>3</sub>), ClO<sub>4</sub><sup>-</sup>, RCO<sub>2</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup>,

20

$\text{HPO}_4^{2-}$ ,  $\text{H}_2\text{PO}_4^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{HSO}_4^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ,  $\text{BF}_4^-$ ,  $\text{PF}_6^-$ ,  $\text{SO}_3^{2-}$ ;  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Ba}^{2+}$ .

The bleaching catalysts to be used according to the invention activate elemental oxygen and peroxy compounds. Peroxy compounds are to be understood as meaning, in particular, hydrogen peroxide, compounds which liberate hydrogen peroxide, such as, in particular, sodium perborate monohydrate, sodium perborate tetrahydrate and sodium percarbonate, perphosphates and persulfates, peroxycarboxylic acids and salts thereof and peroxycarboxylic acid bleaching precursors, so-called activators, and mixtures of such substances. Suitable peroxycarboxylic acids can be aliphatic or aromatic in nature and contain one or more peroxycarboxylic acid groups. Aliphatic peroxycarboxylic acids usually contain 1 to 20 C atoms, preferably 1 to 12 C atoms, and the particularly preferred peroxycarboxylic acid is peroxyacetic acid. Among the peroxycarboxylic acids with 2 peroxycarboxylic acid groups, those having 4 to 18 C atoms are preferred; examples are diperoxyadipic acid, diperoxyazelaic acid, diperoxy lauric acid and diperoxydodecanedioic acid, as well as salts of the acids mentioned, for example magnesium salts. Among the aromatic peroxycarboxylic acids there are, in particular, peroxybenzoic acid, m-chlorobenzoic acid, p-sulfonatoperoxybenzoic acid, diperoxyisophthalic acid, phthalimidopercaproic acid, 4,4'-sulfonyl-diperoxybenzoic acid and magnesium salts of these acids.

30

The peroxycarboxylic acids can also be formed in situ under the use conditions, and in particular from so-called activators, which are in general O-acyl compounds and N-acyl compounds. Such compounds form the corresponding

peroxycarboxylic acid under perhydrolysis conditions in the presence of hydrogen peroxide or a source of hydrogen peroxide. Activators which are particularly preferably to be used are: N,N,N'N'-tetraacetylenediamine (TAED), Na  
5 1-methyl-2-benzoyloxybenzene-4-sulfonate, Na nonanoyloxybenzenesulfonate (NOBS), 2-(N,N,N-trimethylammonium)ethyl-sodium 4-sulfophenylcarbonate chloride (SPCC), pentaacetylglucose, phthalic anhydride.

10 For activation of peroxy compounds, the transition metal complexes to be used according to the invention are in general employed in an amount of about 0.0001 to 50 wt.%, in particular 0.01 to 20 wt.% and particularly preferably 0.01 to 1 wt.%, based on the peroxy compounds.

15

Bleaching agent compositions according to the invention comprise at least one peroxy compound and a transition metal complex to be used according to the invention in an active amount. Such compositions expediently comprise 0.001  
20 to 50 wt.%, in particular 0.01 to 20 wt.% and particularly preferably 0.01 to 1 wt.% of a transition metal complex with a ligand according to the invention, based on the content of peroxy compounds or precursor of one.

25 Bleaching agent compositions according to the invention expediently additionally comprise one or more surfactants from the series consisting of anionic, cationic, zwitter-ionic and nonionic surfactants, in particular surfactants such as are used in conventional washing, bleaching and  
30 cleaning compositions. Bleaching agent compositions according to the invention can furthermore also comprise organic and/or inorganic builders, such as zeolites. Further constituents can be those such as are used in

conventional washing, bleaching and cleaning compositions, including enzymes, pH regulators and conventional alkali metal carriers, such as alkali metal silicate and alkali metal carbonates.

## 5 Examples

### Example 1:

Preparation of the dibenzotetramide 5,8,13,16-tetrahydro-5,8,13,16-tetraaza-dibenzo[a,g]cyclododecene-6,7,14,15-tetraone (TTBP)

- 10 Ligand: A solution of 5.52 g (17.9 mmol) diethyl 1,2-phenylene-dioxamate (preparation in accordance with: J. Am. Chem. Soc. 1993, 115(15), 6738) and 1.94 g (17.9 mmol) 1,2-phenylenediamine in 250 ml toluene was heated under reflux for 8 hours. The product was then filtered off and dried in  
15 vacuo at 50°C. Yield: 29% (pale green solid).

- M complex (M = Fe, Cu, Mn, Co): 500 mg (1.54 mmol) of ligand were dissolved in 50 ml THF under argon and the solution was then cooled to -100°C. 4.2 ml (6.17 mmol) n-  
20 butyllithium (15 per cent in pentane) were added all at once by means of a disposable syringe and, after 15 minutes, 195 mg (1.54 mmol) anhydrous iron(II) chloride were added. The reaction mixture was warmed to room temperature and stirred at this temperature for 22 hours.  
25 Atmospheric oxygen was then passed through the solution in the course of 2 hours. The red-brown solid was filtered off and dried at 50°C in vacuo. Yield: 96%

- Analogously, the Mn complex was prepared with anhydrous MnCl<sub>2</sub> (42%, red-brown solid), the Cu complex with anhydrous  
30 CuCl<sub>2</sub> (70%, dark brown solid) and the Co complex with anhydrous CoCl<sub>2</sub> (83%, dark red solid).



## Example 2:

Preparation of N-methyl-N'-[2-(methylaminooxalylamino)-phenyl]oxalamide (PBOMA)

N,N'-1,2-Phenylene-bis(oxamic acid ethyl ester)

- 5 8.40 g (60.0 mmol) ethoxalyl chloride were added dropwise to a solution of 3.30 g (30.0 mmol) 1,2-phenylenediamine in 150 ml tetrahydrofuran analogously to the instructions in *J. Am. Chem. Soc.* 1993, 115(15), 6738. The solution was heated under reflux for 0.5 hour and solid constituents  
10 were then filtered off. After distillation of the solvent, a little water was added to the oily residue, a colourless solid precipitating out. This was filtered off, washed with water and dried in vacuo. (Yield: 97%)

- 15 Reaction of the diester with methylamine

- 8.24 g (87.5 mmol) methylamine (33% in methanol) were added dropwise to a solution of 9.00 g (29.2 mmol) of the diethyl ester in 50 ml ethanol analogously to the instructions in *J. Chem. Soc. Dalton Trans.* 1997, 745 at room temperature  
20 and the reaction solution was then stirred vigorously for 0.5 hour at 65°C. The colourless solid was filtered off, washed with a little cold methanol and methyl tert-butyl ether and dried in vacuo. (Yield: 82%)

- 25 Co complex of PBOMA:

- 2.62 g (7.18 mmol) cobalt(II) perchlorate dihydrate, which were dissolved in a little methanol beforehand, were added to 2.00 g (7.18 mmol) of the bisamide PBOMA and 11.0 g (30.2 mmol) tetramethylammonium hydroxide in 10 ml  
30 methanol. A pale red solid precipitated out. This was filtered off and dried. (Yield: 84%)

Examples 3 to 8

The complexes of examples 1 and 2 and complexes prepared in an analogous manner or a manner known from the literature were investigated for their catalytic action by means of the Morin test and in some cases by means of a washing test.

Morin test: A sodium perborate monohydrate solution, a methanolic solution of tetraacetythylenediamine and a dilute solution of the combination to be investigated are added to an aqueous Morin solution.

After intensive mixing, the extinction/transmission is measured at 400 nm after 30 minutes at 30°C. The blank value is measured in the absence of the combination to be investigated.

Washing test: Laboratory washing apparatus type ATLAS LAUNDER-O-METER

Temperature: 30 °C

Washing time: 30 minutes

Water hardness: 14°d

Staining: tea, in some cases also grass on cotton

Detergent recipe:

12.2% anionic surfactant

7.7% nonionic surfactant

2.0% soap

34.8% zeolite A

4.2% polycarboxylate

0.5% phosphonic acid

4.1% corrosion inhibitor

1.1% magnesium silicate

1.1% greying inhibitor (CMC)  
2.2% sodium sulfate  
4.1% sodium citrate

Bleaching component:

- 5 17% sodium percarbonate  
5% activator TAED  
Metal complex: 2,400 ppm  
Detergent concentration: 5 g/l

- 10 As a comparison, the base recipe plus percarbonate/TAED,  
but without a metal complex (= catalyst) was always run  
(CE1). This change in reflection compared with the starting  
fabrics is subtracted from the change in reflection  
achieved with percarbonate/TAED/bleaching catalyst.

The results follow from the table:

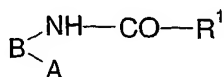
Table:

No.	Complex			Morin test transmission	Washing test ( $\Delta R$ )
	M	L	X or Y		
3	Co	TTBP		94.8	0.2
4	Co	PBOMA	$Y=N(CH_3)_4^+$	94.8	1.9
5a	Co	OPBA		13	1.5
5b	Cu	OPBA		13.8	n.d.
5c	Fe	OPBA		5.8	n.d.
6	Mn	OPBA	$X=(\mu O)_2$ $Y=(Na^+)_4$	4.2	n.d.
7	Mn	BPEN		8	n.d.
8a	Co	PCADB	$X=(Cl^-)_2$ $Y=(Na^+)_4$	6.2	n.d.
8b	Fe	PCADB	$X=(Cl^-)_2$ $Y=(Na^+)_4$	46	n.d.

The test results show that the catalysts according to the invention, in particular cobalt complexes, lead to a high increase in the activity of the peroxyacetic acid formed in situ from an activator (TAED) and perborate.

## Patent claims:

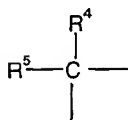
1. Use of a transition metal complex with at least one nitrogen-containing polydentate ligand as a bleaching catalyst for activation of a peroxy compound or of oxygen, wherein
- 5 the complex is mono- or polynuclear, the transition metal (M) is manganese, iron, cobalt or copper and the nitrogen-containing polydentate ligand (L), at least one of which is present, has the general formula (I)



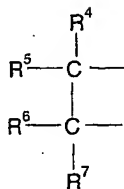
- 10 wherein A represents either the group -NH-CO-R<sup>2</sup> or the group -C=N-OZ,



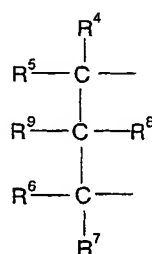
the bridge member B is chosen from the series consisting of



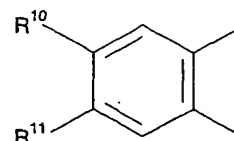
(B0)



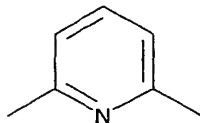
(B1)



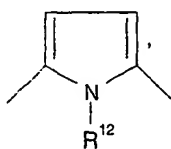
(B2)



(B3)



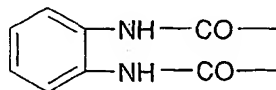
(B4)



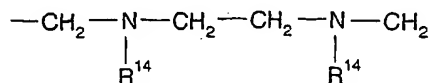
(B5)

15

wherein  $R^4$  to  $R^7$  independently of one another represent a radical from the series consisting of H, arylalkyl, aryl, heteroaryl,  
 wherein  $R^4$  with  $R^5$  or/and  $R^6$  with  $R^7$  or  $R^4$  with  $R^6$   
 5 together with the atom(s) carrying them can form a five- to seven-membered cycloaliphatic or O- or N-heterocyclic ring, which can also contain a double bond,  
 and wherein the structural elements of the general formulae (B0) to (B5) have a total of 2 to 20 C atoms,  
 10  $R^8$  and  $R^9$  independently of one another can represent a radical from the series consisting of H, methyl or together can represent carbonyl oxygen,  
 $R^{10}$  and  $R^{11}$  independently of one another can represent a radical from the series consisting of H,  $(C_1-C_4)$ alkyl,  
 15 halogen or together can represent a fused-on aromatic ring  
 and  $R^{12}$  can represent H or methyl,  
 the radicals  $R^1$  and  $R^2$  independently of one another can represent a radical from the series consisting of  $-COOH$ ,  
 20  $-CONH_2$ ,  $-CONHR^{13}$ ,  $C(CH_3)_2OH$ , 2-pyridyl, 1,3-oxazolin-2-yl, imidazol-2-yl or  $R^1-R^2$  together can represent the radical



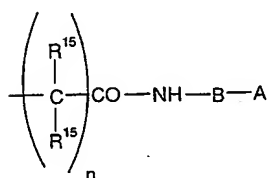
or



25

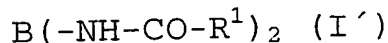
wherein  $R^{13}$  can be chosen from the series consisting of linear, branched or cyclic alkyl, aryl, heteroaryl, in particular 2-pyridyl, 1,3-oxazolin-2-yl and imidazol-2-yl and heteroalkylmethyl,  
 30  $R^{14}$  can be chosen from the series consisting of substituted or unsubstituted, linear, branched or cyclic

alkyl, benzyl, aryl, heteroaryl, heteroarylmethyl, and  
 $R^3$  represents a radical from the series consisting of  
 alkyl, aryl, heteroaryl, arylalkyl, heteroarylalkyl and  
 Z represents H, alkyl, aryl, dialkylaminoethyl,  
 5 heteroaryl  
 and in the case of the oximes  $R^1$  additionally can  
 represent the radical



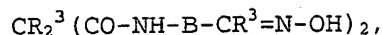
wherein n is 0 or 1,  $R^{15}$  can be H or alkyl and  $R^{15}-C-R^{15}$   
 10 can be cycloalkyl.

2. Use according to claim 1,  
 characterized in that  
 the ligand L has the general formula



15 wherein B represents unsubstituted or substituted ortho-  
 phenylene, wherein the substituents can be bonded in  
 particular in the 4,5-position and can be Cl; F or  $\text{CH}_3$ ,  
 and/or  $R^1$  is chosen from the series consisting of  $\text{COOH}$ ,  
 $\text{CO}-\text{NH}-\text{CH}_3$ ,  $\text{C}(\text{CH}_3)_2\text{OH}$ , 2-pyridyl, 1,3-oxazolin-2-yl and  
 20 imidazol-2-yl or  $R^1$  represents a radical from the series  
 consisting of phenylenediamine-N,N'-dicarbonyl or  
 $\text{CH}_2-\underset{\text{R}^{14}}{\text{N}}-\text{CH}_2-\text{CH}_2-\underset{\text{R}^{14}}{\text{N}}-\text{CH}_2-$ , where  $R^{14}$  is  $-\text{CH}_2-\text{COOH}$ .

3. Use according to claim 1 or 2,  
 25 characterized in that  
 the ligand L in the diamide-dioxime corresponds to the  
 general formula



wherein B represents substituted ortho-phenylene and  $\text{R}^3$  represents methyl.

4. Use according to one of claims 1 to 3  
5 characterized in that  
the complex has the general formula  $[\text{L}_m\text{M}_n\text{X}_o]\text{Y}_p$ ,  
wherein L denotes a ligand according to one of claims 1  
to 6  
M denotes a transition metal from the series consisting  
10 of Mn(II) to Mn(IV), Fe(II), Fe(III), Co(II), Co(III),  
Cu(I) and Cu(II), in particular Co(II) or Co(III),  
X denotes a coordinating neutral or charged mono- or  
polyvalent ligand for saturation of the ligand sphere  
and  
15 Y denotes a non-coordinating counter-ion which can be  
anionic or, if the sum of anionic substituents in the  
ligand L exceeds the sum of the valency of the metal  
atoms M, can also be cationic,  
m denotes an integer in the range from 1 to 4, in  
20 particular 1 or 2,  
n denotes the number 1 or 2,  
o denotes zero or an integer in the range from 1 to 8  
and  
p denotes zero or an integer in the range from 1 to 8,  
25 in order to achieve complete charge compensation.
5. Use according to claim 4,  
characterized in that,  
a complex of the general formula  $[\text{LMX}_o]\text{Y}_p$  or  $[\text{L}_2\text{M}_2\text{X}_o]\text{Y}_p$ ,  
wherein the bridge member B of the ligand  $\text{B}(\text{NH-CO-R}^1)_2$   
30 denotes ortho-phenylene or 4,5-dichlorophenylene and  $\text{R}^1$   
denotes a radical from the series consisting of COOH,  
CONHCH<sub>3</sub>, C(CH<sub>3</sub>)<sub>2</sub>OH and 2-pyridyl, is employed.
6. Use according to one of claims 1 to 5,  
characterized in that



hydrogen peroxide or a peroxycarboxylic acid having 2 to 18 C atoms, which can also have been formed in situ from a source of hydrogen peroxide and an activator from the series consisting of O-acyl or N-acyl compounds, is  
5 activated.

7. Use according to one of claims 1 to 6 characterized in that the transition metal complex is employed in an amount of 0.0001 to 50 wt.%, based on the peroxy compound.
- 10 8. Bleaching agent composition comprising a peroxy compound and a transition metal complex in an amount effective for activation of the peroxy compound, characterized in that it comprises a transition metal complex according to one  
15 of claims 1 to 5.
9. Bleaching agent composition according to claim 8, characterized in that the peroxy compound is chosen from the series consisting of hydrogen peroxide, a source of hydrogen peroxide, in  
20 particular an alkali metal perborate monohydrate tetrahydrate or alkali metal percarbonate, a peroxycarboxylic acid having 2 to 18 C atoms or a combination of a source of hydrogen peroxide and a peroxycarboxylic acid precursor, in particular an O-acyl  
25 or N-acyl compound, or from mixtures thereof.
10. Bleaching agent composition according to claim 8 or 9, characterized in that it additionally comprises one or more surfactants, in particular wash-active surfactants.
- 30 11. Bleaching agent composition according to one of claims 8 to 10, characterized in that

it additionally comprises builders, in particular zeolites.

12. Bleaching agent composition according to claim 10 or 11,

5 characterized in that  
it is a constituent of a washing, bleaching or cleaning composition comprising one or more surfactants and one or more builders.

13. Bleaching agent composition according to one of claims 10

8 to 12,  
characterized in that  
it comprises 0,0001 to 50 wt.%, in particular 0.01 to 20 wt.% of a transition metal complex according to one of claims 1 to 7, based on the content of peroxy  
15 compound or precursor thereof.

## INTERNATIONAL SEARCH REPORT

 Internat Application No  
 PCT/EP 03/05674

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 C11D3/39

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 98 03263 A (CARNEGIE MELLON UNIVERSITY (US)) 29 January 1998 (1998-01-29) cited in the application the whole document	1-13
A	US 2002/058598 A1 (AVILA DAVID VICTOR) 16 May 2002 (2002-05-16) the whole document	1-13
A	US 2001/003737 A1 (REINEHR DIETER ET AL) 14 June 2001 (2001-06-14) the whole document	1-13
A	US 5 969 171 A (NESTLER BERND) 19 October 1999 (1999-10-19) the whole document	1-13
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Date of the actual completion of the international search

3 September 2003

Date of mailing of the international search report

11/09/2003

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 241 779 B1 (HORWITZ COLIN P ET AL) 5 June 2001 (2001-06-05) the whole document.	1-13
P, A	US 2002/165110 A1 (REINHARDT GERD ET AL) 7 November 2002 (2002-11-07) the whole document	1-13
P, A	US 2002/134965 A1 (DANJO HIROSHI) 26 September 2002 (2002-09-26) the whole document	1-13
A	WO 02 16330 A (UNILEVER PLC (GB); UNILEVER NV (NL); HINDUSTAN LEVER LIMITED (IN)) 28 February 2002 (2002-02-28) the whole document	1-13

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## INTERNATIONAL SEARCH REPORT

Information on patent family members

Internation	Application No
PCT/EP 03/05674	

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9803263	A	29-01-1998	US 5847120 A	08-12-1998
			AP 919 A	29-12-2000
			AT 229372 T	15-12-2002
			AU 729102 B2	25-01-2001
			AU 4043697 A	10-02-1998
			BR 9710513 A	05-03-2002
			CA 2261589 A1	29-01-1998
			CN 1230903 A	06-10-1999
			DE 69717819 D1	23-01-2003
			DE 69717819 T2	10-07-2003
			DK 914206 T3	07-04-2003
			EP 0914206 A1	12-05-1999
			ES 2188969 T3	01-07-2003
			JP 2000515152 T	14-11-2000
			NO 990268 A	22-03-1999
			NZ 333797 A	23-06-2000
			PL 331315 A1	05-07-1999
			PT 914206 T	30-04-2003
			US 6100394 A	08-08-2000
			US 6054580 A	25-04-2000
			WO 9803263 A1	29-01-1998
US 2002058598	A1	16-05-2002	AU 8974401 A	02-04-2002
			BR 0114004 A	12-08-2003
			CA 2421758 A1	28-03-2002
			WO 0224852 A1	28-03-2002
			EP 1319061 A1	18-06-2003
US 2001003737	A1	14-06-2001	AU 7564596 A	11-06-1997
			EP 1021516 A1	26-07-2000
			JP 2000500518 T	18-01-2000
			WO 9719162 A1	29-05-1997
			GB 2307250 A	21-05-1997
US 5969171	A	19-10-1999	DE 19728021 A1	07-01-1999
			BR 9802311 A	14-12-1999
			EP 0889050 A2	07-01-1999
			JP 11140037 A	25-05-1999
US 6241779	B1	05-06-2001	US 6136223 A	24-10-2000
			US 5853428 A	29-12-1998
			US 5876625 A	02-03-1999
			AU 763682 B2	31-07-2003
			AU 3977899 A	29-11-1999
			BR 9910409 A	09-01-2001
			CA 2332134 A1	18-11-1999
			CN 1309689 T	22-08-2001
			EP 1078033 A1	28-02-2001
			JP 2002514693 T	21-05-2002
			NO 20005505 A	09-01-2001
			PL 344182 A1	08-10-2001
			WO 9958634 A1	18-11-1999
			AP 905 A	27-11-2000
			AT 233312 T	15-03-2003
			AU 720042 B2	25-05-2000
			AU 3735297 A	10-02-1998
			BR 9710514 A	24-10-2000
			CA 2261229 A1	29-01-1998

Form PCT/ISA/210 (patent family annex) (July 1992)

## INTERNATIONAL SEARCH REPORT

Information on patent family members

Interna Application No

PCT/EP 03/05674

Patent document cited in search report		Publication date	Patent family member(s)	Publication date		
US 6241779	B1		CN 1230980 A	06-10-1999		
			DE 69719337 D1	03-04-2003		
			DK 923635 T3	23-06-2003		
			EP 0923635 A2	23-06-1999		
			JP 2000515194 T	14-11-2000		
			NO 990267 A	15-03-1999		
			NZ 333795 A	28-07-2000		
			PL 331352 A1	05-07-1999		
			RU 2193049 C2	20-11-2002		
			WO 9803626 A2	29-01-1998		
			AP 1013 A	27-09-2001		
			AT 225844 T	15-10-2002		
			AU 730906 B2	15-03-2001		
			AU 3665597 A	10-02-1998		
			BR 9710538 A	17-08-1999		
			CA 2261228 A1	29-01-1998		
			CN 1230979 A	06-10-1999		
			DE 69716275 D1	14-11-2002		
			DE 69716275 T2	10-07-2003		
			EP 0918840 A1	02-06-1999		
			ES 2186906 T3	16-05-2003		
			JP 2001503073 T	06-03-2001		
			NO 990266 A	22-03-1999		
			NZ 333796 A	29-09-2000		
			PL 331316 A1	05-07-1999		
			RU 2193050 C2	20-11-2002		
			WO 9803625 A1	29-01-1998		
			US 6099586 A	08-08-2000		
		US 2002165110	A1	07-11-2002	DE 10102248 A1	25-07-2002
					EP 1225215 A2	24-07-2002
	JP 2002302698 A			18-10-2002		
US 2002134965	A1	26-09-2002	DE 10200672 A1	11-07-2002		
			JP 2002275499 A	25-09-2002		
WO 0216330	A	28-02-2002	AU 7981601 A	04-03-2002		
			BR 0113379 A	24-06-2003		
			CA 2419864 A1	28-02-2002		
			WO 0216330 A1	28-02-2002		
			EP 1311493 A1	21-05-2003		

Form PCT/ISA/210 (patent family annex) (July 1992)